RESEARCH, DEVELOPMENT, AND TECHNOLOGY TRANSFER GUIDELINES FOR THE MONTANA DEPARTMENT OF TRANSPORTATION

FHWA/MT-05-006/8010-2

Guidelines

prepared for
THE STATE OF MONTANA
DEPARTMENT OF TRANSPORTATION

in cooperation with
THE U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

December 2005

prepared by

Susan C. Sillick
Craig Abernathy

Montana Department of Transportation

RESEARCH PROGRAMS

Montana Department of Transportation

MDT

serving you with pride

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TECHNOLOGY TRANSFER GUIDELINES
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16. Abstract

The Montana Department of Transportation (MDT) conducts research to discover, develop, or extend knowledge needed to operate, maintain and improve the statewide multimodal transportation system. Specific goals include: evaluation and advancement of new technologies, materials and methods; development of design and analysis techniques; and study of current transportation challenges.

The purpose of this manual is to provide guidance for the development and management of effective MDT Research Programs. Through the identification of the various research related functions and operational procedures of the MDT, this manual will produce a model of a research management system. The programs, projects, and products generated by the Research Programs, using the management system, are provided for the ultimate benefit of MDT's customers.

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SUMMARY

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The purpose of this manual is to provide guidance for the development and management of effective MDT Research Programs. Through the identification of the various research related functions and operational procedures of the MDT, this manual will produce a model of a research management system. The programs, projects, and products generated by the Research Programs, using the management system, are provided for the ultimate benefit of MDT's customers.

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CHAPTER 1
PURPOSE AND CONTEXT OF MANUAL

1.1 Purpose

The primary purpose of this manual is to provide guidance for the development and management of effective MDT Research Programs. Through the identification of the various research related functions and operational procedures of the MDT, this manual will produce a model of a research management system. The programs, projects, and products generated by the Research Programs, using the management system, are provided for the ultimate benefit of MDT's customers.

To ensure the effectiveness of the MDT's research processes and programs, several key objectives are presented in this manual:
- Determining the usefulness and implementation potential of the research conducted by or through the MDT;
- Ensuring that research results are implemented;
- Assessing research using project and program accomplishments; and
- Improving research through the coordination of several disciplines.

1.2 Overview

This manual covers the Research Programs from program development through program evaluation, including technology transfer and the management requirements needed to maintain effective Research Programs.

This chapter (Purpose and Context of Manual) defines the need for and provides a brief overview of the contents of this manual.

Chapter 2, Customer Involvement, details the processes used to increase the interactive nature of MDT's Research Programs. It also explains the purpose and structure of research committees.

Chapter 3, Work Program Development, details the process for the development of the work program. It includes the solicitation and prioritization process, from developing a problem statement request to the screening effort conducted by the Research staff and committees. A review and prioritization of the research problem statements leads to the formation of the work program.

Chapter 4, Experimental Projects, explains the Experimental Projects Process, including the incorporation of experimental features into construction and maintenance projects and the evaluation of these projects.

Chapter 5, Technology Transfer, gives an overview of one of the most important activities in the research process by defining the research partners, project tracking issues, and outreach techniques. This includes library services and the input of projects to the Transportation Research Board's (TRB) Research in Progress (RiP) and Transportation Research Information Service (TRIS) databases, and the use of RiP and TRIS for program development.

Chapter 6, Program Evaluation, lists the elements that give a measure of accomplishment of the Research Programs. These elements include the status of each project, the techniques for evaluating the entire Research Programs and the details of the peer exchange process.

Appendix A, Model Calendar, contains a calendar of research events.

Appendix B, Research Problem Statement, is the form used to submit research project ideas.

Appendix C, Research Project Statement, is the form used to develop a scope of work.

Appendix D, Preparation and Submission of Proposals, contains guidance on proposal writing.

Appendix E, Report Distribution, lists the entities to which research reports are distributed.

CHAPTER 2
CUSTOMER
INVOLVEMENT

2.1 Research Partners' Support Development

As previously stated, the programs, projects, and products of the MDT's Research Programs are for the ultimate benefit of MDT's customers. Attaining this objective requires the support of our research partners. Their support can best be achieved by involving them in the process of developing the programs and generating the products. This assures that their needs are considered at all times and facilitates the implementation of research products.

The transportation community is broad and multimodal. Research partners come from the ranks of the MDT, universities, transportation-related companies (trucking firms, suppliers, contractors, etc.), transit authorities, tribal authorities, consultants, local governments, regional agencies, other states, FHWA, and the public. The partners involved and their level of involvement varies depending on area of involvement.

Potential partners are solicited for research needs. Solicitations are given the widest possible circulation and exposure to enhance the possibility of receiving a large variety of suggested research topics. Section 3.1, Problem Solicitation, defines this process.

Partners are represented on specific research projects program's committees, as described in section 2.2, Research Committees Structure. The committee serves as the most formal of the interactive techniques and provides non-MDT institutions the forum to affect policy. Partners also help to guide the Experimental and Technology Transfer Programs, as described in Chapters 4 and 5, respectively.

MDT sponsored research seminars introduce broader issues with researchers, users and other experts in a specific field. These seminars offer presentations and discussions directed to improve the understanding of issues and promote research efforts for MDT. Principal investigators conduct a seminar upon the completion of their research projects. Other seminars are conducted on an as needed basis.

The success of the MDT's Research Programs hinges on our ability to develop strong and lasting interactive relationships with all the beneficiaries of research. The outreach partners and their forums will assist with program development, consensus building, implementation, technical input, and the strengthening of partnerships.

2.2 Research Committees Structure

Researchers seek to effect quality improvement by studying ways to enhance the processes, methods, or materials presently in use. The change inherent in an

enhancement may come easier to the practitioner who is currently doing an effective job with a concerted effort to elicit their input and support. Of the many activities delineated to develop and maintain research partners' support under Section 2.1, Research Partners' Support Development, the committee structure is perhaps the most important.

Through committees, Research Programs staff will formally maintain contact with the operating units of the MDT and outside institutions. Meetings are often more effective than a phone call or office visit in that they expose non-Research members of the committees to a formal interactive process and show that a concerted effort is being made to elicit their support.

When they are properly functioning, committees are useful in providing input for the solicitation of problems, setting priorities for projects, developing the work program, giving advice and general guidance, and serving as important conduits for the implementation and transfer of research results.

2.2.1 Research Review Committee (RRC)

The RRC oversees MDT's Research Projects Program efforts. Its responsibilities include:
- ➤ Advising the Research Programs;
- ➤ Prioritizing Research Problem Statements (Appendix B) along with the District Administrators;
- ➤ Approving new projects and participation in pooled-fund studies;
- ➤ Bolstering the implementation efforts of the technical panels (section 2.2.2); and
- ➤ Approving the annual work program (section 3.6).

The committee's membership is broad and includes most of the MDT Divisions, as follows:
- ➤ Administration Division Administrator;
- ➤ Aeronautics Division Administrator;
- ➤ Deputy Director;
- ➤ Director;
- ➤ District Representative;
- ➤ Highways and Engineering Division Administrator;
- ➤ Highway Traffic Safety Officer;
- ➤ Information Services Division Administrator;
- ➤ Maintenance Division Administrator;
- ➤ Motor Carrier Services Division Administrator;
- ➤ Planning and Research Engineer, Montana Division, Federal Highway Administration;
- ➤ Rail, Transit, and Planning Division Administrator; and
- ➤ Research Programs Manager.

The Research Programs Manager chairs the committee and serves as its secretary. This committee conducts open meetings monthly in Helena.

2.2.2 Technical Panels

Technical panels are formed to follow research projects from inception through implementation. Technical panels are typically composed of three to ten people with knowledge or expertise, and interest in the specific area of research. Panel members are drawn from MDT's Division and District offices, as well as from outside the Department. They are also balanced with respect to rank and viewpoint.

Technical Panel membership is chosen by Research staff, in conjunction with the technical panel chairperson, with input from other MDT personnel, and includes at least one Research staff member, who serves as the panel secretary. Technical panels conduct open meetings as often as needed to perform their tasks in a timely fashion. Meeting locations accommodate the membership.

The technical panel's responsibility begins with a review of the literature to determine the need for research, if any, and continues with the development of the Research Problem Statement (Appendix B) into a viable research plan. This plan should be formulated using the Research Project Statement form (Appendix C) and should include: what tasks need to be accomplished; how much time and money needs to be expended; who should perform the research; and what research products should be delivered to facilitate implementation.

During and following the research, the Research representative on each technical panel serves as MDT's project manager and liaison between the technical panel and the consultant. The technical panel monitors research progress by reviewing quarterly, final, and any other reports produced by the principal investigator. Finally, the technical panel makes implementation recommendations to the appropriate MDT Administrator, through the RRC.

CHAPTER 3
WORK PROGRAM DEVELOPMENT

3.1 Problem Solicitation

Once a year, the Research Programs Manager solicits research ideas from as wide a variety of individuals as possible. This open solicitation enhances the possibility of receiving a diverse sampling of research suggestions.

Suggestions for research are made on Research Problem Statement forms (Appendix C). This form requires a problem title and statement, as well as information on the proposed research, information technology (IT) components (i.e., database development and software purchase or development), urgency and expected benefits of the proposed research, and implementation plan. These statements provide enough information to allow the RRC to appreciate the significance of the problem, but do not elaborate on details. Research Problem Statements can be submitted at any time; however, they may be considered only once a year following each solicitation. All submitters will receive an acknowledgment of receipt of their problem statement from Research Programs staff.

Before a problem statement can be prioritized, it must have a champion and a sponsor. A champion is internal to MDT, and is willing to support the problem statement to the RRC and serve as the technical panel chairperson should the problem statement move forward to this stage. In doing this, the champion asserts that there is a research need and that this need is important to MDT. A sponsor is a District/Division Administrator or higher that agrees the research is important to MDT and is willing to ensure implementation occurs. Only problem statements with both a champion and sponsor move forward to the project prioritization stage. Problem statements without either a champion or sponsor may be submitted again for a future solicitation.

3.2 Project Prioritization and Selection

The champions for each problem statement present their topic to the RRC and District Administrators for individual rating. Each member of these two groups rates every problem with respect to their overall worth, timeliness, and attainability. These individuals also have the opportunity to comment on each problem. Research staff compiles the comments and average ratings for each problem, with the overall worth equaling 50%, timeliness equaling 30% and attainability equaling 20% of the total score.

The RRC then reviews the ratings and comments, and selects the high priority topics for that solicitation cycle. These topics are chosen because they address actual concerns of the Department rather than topics of specific interest to individual researchers. Research Programs

staff will inform all submitters on the status of their topic. Topics not chosen to move forward may be resubmitted in a future solicitation.

Following the selection of these high priority topics, Research Programs staff forms a technical panel (see section 2.2.2) for each topic.

3.3 Technical Panel Evaluation

Each technical panel is first responsible for determining the need for research using the panel's collective knowledge and reviewing current and published research through a search of the Transportation Research Board's Research in Progress (RiP) and Transportation Research Information Services (TRIS) databases, at a minimum. If the information already exists or if current research will solve the problem, results are used as appropriate and no further research is warranted. If there is no information already available to solve the problem, the panel decides if there is a need for the research. If not, the panel recommends to the RRC that the project be cancelled. If a need for research exists, the panel determines the scope of work, how much time and money should be expended, and who should conduct the research. Most importantly, the panel determines what products are needed for implementation, what barriers exist that might prevent implementation, and how to reduce or eliminate these barriers because implementation is key to a successful project.

The panel may chose to give the work to another governmental agency, such as a Montana university; this is only done for small projects (see below) or when there is a close fit between MDT's needs and the researcher's capabilities. Alternatively, the panel may choose to obtain proposals through the request for proposal (RFP) process; this is the more common method of obtaining project proposals. The panel recommends the best proposal to the RRC for funding approval.

The importance of the written proposal (Appendix D) cannot be overemphasized; it is the RRC's only means of selecting which studies to fund. The proposal must be concise, clear, and complete. Most importantly, it must convince the RRC that a sound research project will follow. The RRC approves research proposals until funding is depleted for that federal fiscal year. Other research proposals deemed necessary will be delayed until the beginning of the next fiscal year.

The research projects process as detailed above is shown in Figure 1. In addition to the solicitation process (as described above), there are a number of other methods to initiate research projects: Montana Partnership for the Advancement of Research in Transportation (MPART Small Projects), Wildlife and Fisheries Memorandum of Agreement (MOA), and Administration High Priority topics (Figure 1). MDT has contracts in place with both Montana State University and The University of Montana for small projects (<$25,000 and 1 year) under our MPART Small Projects agreement. If there is a need for a small project, such as a synthesis project, which includes a review of the literature and a survey of the

state of the practice, similar to NCHRP synthesis projects, the below steps are followed:

- ➢ Champion notifies research of need;
- ➢ Technical panel is formed;
- ➢ Proposal is obtained;
- ➢ Technical panel recommends proposal for funding to RRC; and
- ➢ RRC approves or denies funding request.

Also, MDT has a MOA with both universities for the conduct of wildlife and fisheries research. A standing technical panel exists for these projects. As funding is available, the technical panel meets to determine needs and issues a RFP to both universities. The panel reviews proposals and recommends funding for the top proposals in each funding area. The RRC either approves or denies funding.

Finally, if MDT Administration identifies a research need that requires immediate attention, the Research Programs manager is informed, a technical panel is formed, and a proposal(s) is obtained and approved either by the RRC or Administration.

SOLICITATION
November-December

CHAMPION IDENTIFIED
AND ADMINISTRATOR
APPROVAL (SPONSOR)
January

NO → Idea is filed

YES

**CHAMPIONS PRESENT
TO RRC/DA's**
January

RRC/DA's RATE IDEAS
January-February

HIGH PRIORITY
February

NO → Idea is filed

YES

**RESEARCH STAFF
FORM TECHNICAL
PANELS (TP)**

FISHERIES & WILDLIFE
AND TRANSPORTATION
MOA/TP

**TP INVESTIGATES
PROBLEM/DETERMINES
DIRECTION**

MDT STAFF IDENTIFY
NEED FOR SHORT-TERM/
LOW-COST PROJECT
(MPART SMALL PROJECT)

RESEARCH NEED

NO → TP makes implementation
recommendation and/or recommends
that RRC cancel project

YES

LOCAL RESEARCH
NEED/ MT IS LEAD

REGIONAL OR NATIONAL
RESEARCH NEED

**TP RECOMMENDS
PROPOSAL TO RRC**

**TP SUBMITS IDEA TO
NCHRP/POOLED-FUND
PROGRAM**

RRC ACCEPTS/REVISES
PROPOSAL

NO → TP recommends
that RRC cancel project

YES

ADMINISTRATION
IDENTIFIES HIGH
PRIORITY RESEARCH
NEED

CONDUCT OF RESEARCH

**TP MAKES
IMPLEMENTATION
RECOMMENDATIONS**

IMPLEMENTATION
Division Administrator
Responsibility

**TP RECOMMENDS
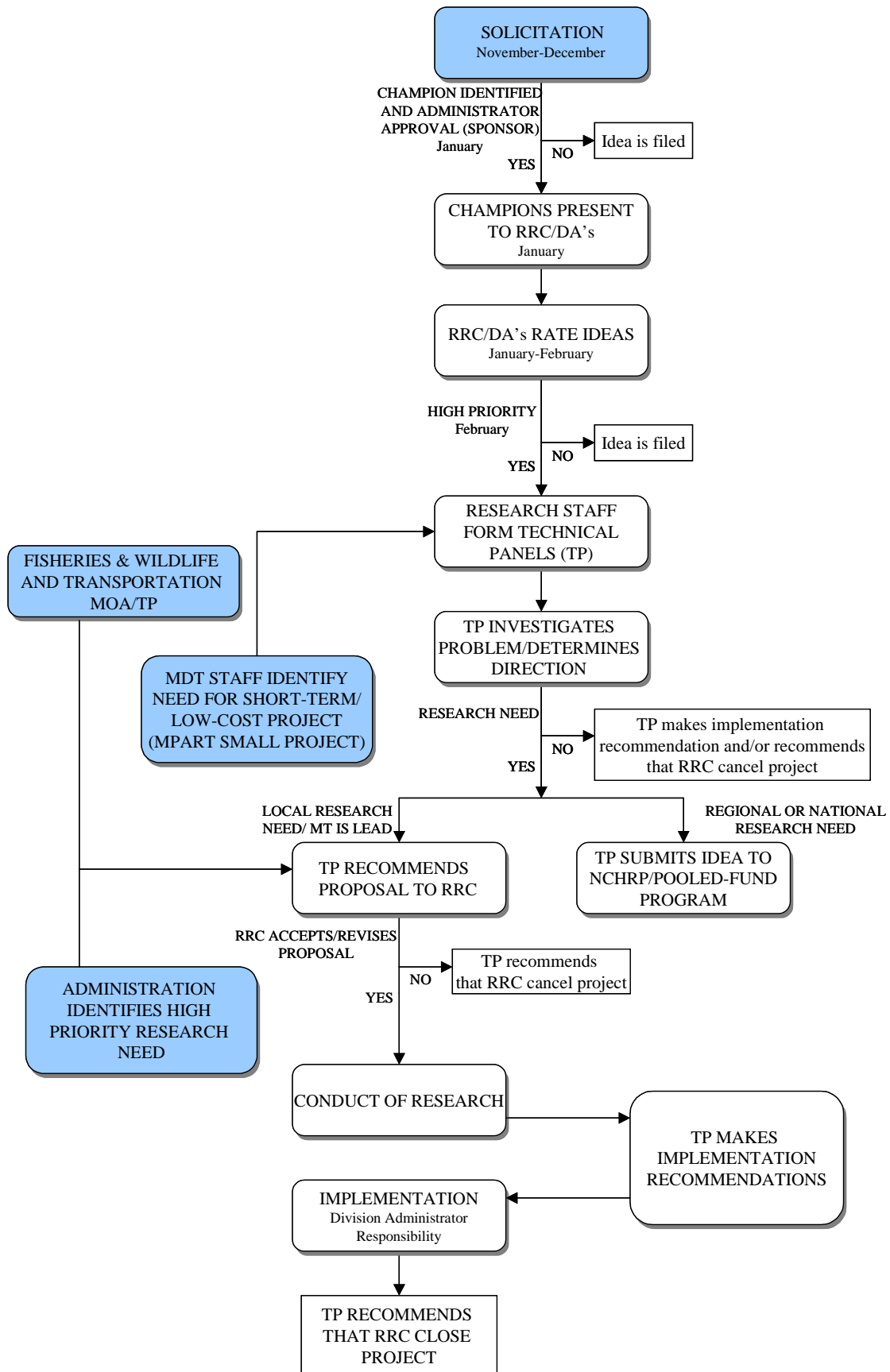THAT RRC CLOSE
PROJECT**

Figure 1: Research Projects Process

3.4 Conduct of Research and Implementation of Research Results

After a research proposal has been approved by the RRC, Research Programs staff executes a formal agreement for the work, which includes the researcher's proposal by attachment and sends a notice to proceed to the consultant. The researcher then conducts the research in accordance with the terms of the agreement.

The project's technical panel monitors the research throughout its duration, with the Research Programs staff member serving as the MDT Research Project Manager and liaison between the consultant and the technical panel. Technical panel members review quarterly progress reports submitted by the researcher, as well as any interim reports specifically required by the agreement. The panel may also visit the research site and interact with the principal investigator as needed. It is the panel's responsibility to ensure the researcher fulfills the terms of the agreement and the research objectives are met. Prior to the conclusion of the research, the panel reviews the draft final report and draft project summary and advises the researcher through the MDT Research Project Manager of any changes that are required.

Upon completion of the study, the research and implementation recommendations will be presented by the principal investigator both in written (final report and project summary) and oral (research seminar) format. The technical panel is responsible for evaluating the validity of the research and implementation recommendations and reporting its findings. These reports will be made to MDT Administrators, through RRC (Figure 2). Following completion of the implementation, the Technical Panel is dissolved.

With the exception of emergency research needs, the Department will follow the process described above and illustrated in Figures 1 and 2.
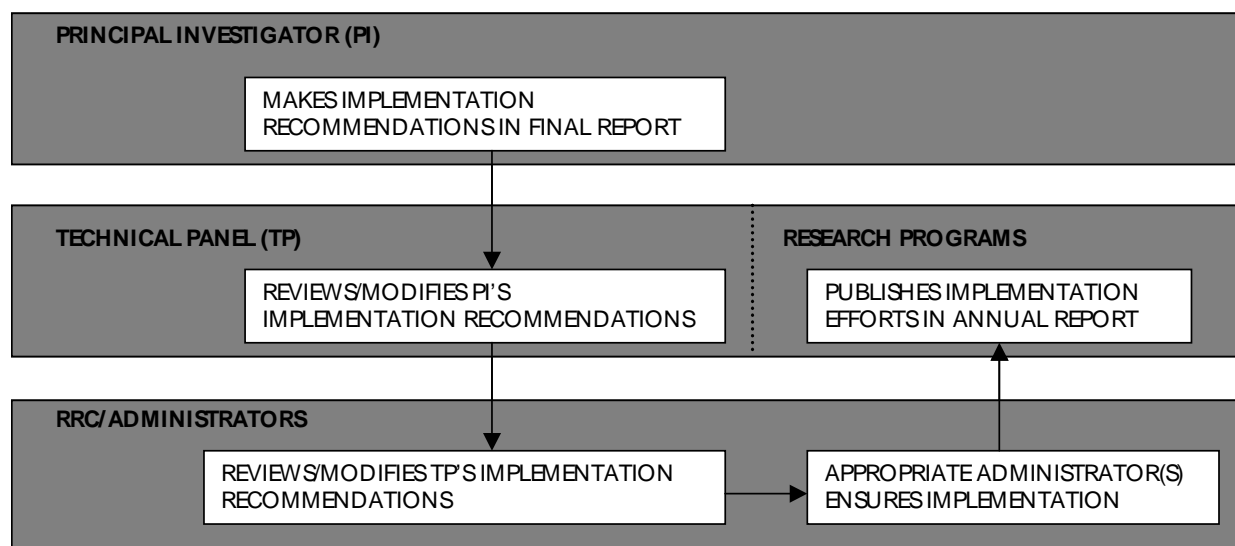

Figure 2: Implementation Process

3.5 Funding

Federal fuel tax monies made available to the State of Montana under Title 23, U.S.C., with appropriate state matching funds are currently the main source of funding for the MDT Research Programs. Since ISTEA (1991) 2% of the total annual transportation disbursement has been allocated to each state for "State Planning and Research" (SPR) activities with a minimum of 25% of these funds reserved for state transportation Research, Development, and Technology Transfer (RDT) efforts.

3.6 Annual Program and Budget

The activities of the Research Programs are concisely and completely described in a single document—the work program. The elements of the work program describe the technical and financial responsibilities on an annual basis.

In addition to research projects initiated as described in Sections 3.1 to 3.4, MDT supports national research through TRB's National Cooperative Highway Research Program (NCHRP) and MDT staff may recommend support of various pooled-fund projects to the RRC.

Setting priorities for the problems received in the solicitation process (section 3.1), small projects, fisheries and wildlife research, and through shared funding arrangements (pooled-fund projects) and partially supported institutions (NCHRP) allow Research Programs staff to develop a work plan within its financial limits. This process ensures that the MDT's most important problems will be addressed and advanced for consideration.

The Research Programs' work program includes:
- ➢ Summary listing of the major items and a cost estimate for each item;
- ➢ Description of each activity or individual research project to be accomplished during the federal fiscal year (October 1 - September 30);
- ➢ Description of any cooperatively funded studies, including pooled-fund studies and NCHRP contributions; and
- ➢ Financial summaries showing the funding levels and share (Federal, State and other sources) for R, D&T activities.

The work program is submitted to the Federal Highway Administration (FHWA) Division office for approval and authorization.

MDT employs a July 1 state fiscal year budget/accounting system in which expenditures and revenues are estimated for the upcoming biennium. In this effort, Research Programs financial projections are developed and submitted by the Research Programs Manager. The Research Programs budget typically contains a sizeable line item for "Contingency and New Research", since the precise program configuration is not known at this point in the year.

In broadest terms, the MDT Research Program funding is divided into two elements: nondiscretionary and discretionary. The non-discretionary element of the program covers the costs of fixed items, such as: personnel and overhead; evaluation of experimental projects; and annual payments in support of the Transportation Research Board (Research Correlation Service) and the National Cooperative Highway Research Program (NCHRP). The discretionary element of the program falls under the purvey of the RRC, which decides the relative importance of the specific research and pooled-fund projects and allocates funds accordingly.

CHAPTER 4
EXPERIMENTAL PROJECTS

The incorporation of experimental features into construction and maintenance projects allows for a vital field evaluation of new materials and methods. This evaluation, if performed well and scientifically based, allows MDT to determine the implementation value of these new materials and methods.

The Experimental Projects Manager (EPM) of the Research Programs staff should be involved throughout this process, from the very first discussions indicating the construction of an experimental feature through the final evaluation and reporting to the FHWA as well as the implementation process. EPM involvement ensures the: need exists to test specific materials or methods through a RiP and TRIS search, at a minimum; appropriate design of experimental features, including appropriate controls; proper construction of experimental features and controls through on-site visits; valid evaluation of performance, based on precise, accurate, and objective measurements; timely annual and final reporting as required by the FHWA; and appropriate implementation of those experimental features that performed well and were cost effective.

Following the formal evaluation period, the Research Programs staff will present the findings including implementation recommendations to MDT management. If it is determined that further performance information may be useful, Research Programs staff may continue to evaluate experimental projects, as informal experimental projects, following the completion of their formal evaluation period.

Field Research Coordinators (FRC's) from each District serve as liaisons between the EPM and the Districts. The FRC's are responsible for informing the EPM of any planned experimental features, the dates of construction of these features, and any project meetings. They also are responsible for assisting with technology transfer in the Districts.

4.1 Work Plan

Prior to construction of an experimental feature, the EPM writes and submits a formal work plan to the FHWA for their approval. This work plan should include the following information:
- Location of project;
- Construction project number;
- Title (type) of project;
- Principal investigator;
- Statement of objectives;
- Experimental design;

- ➢ Estimated quantities and costs;
- ➢ Evaluation schedule; and
- ➢ Reporting requirements.

This work plan is important as it formalizes the project with FHWA, which yields two additional benefits:
- ➢ If the project should fail prematurely, FHWA will participate in the repair at the same percent as is the original construction and
- ➢ Proprietary features may be specified.

4.2 Construction Report

Following the construction of an experimental feature, the EPM is required to submit a construction report for statewide distribution through the Research Programs. This report should be written within thirty days of completed construction of the project and should include:
- ➢ Location of project;
- ➢ Construction project number;
- ➢ Title (type) of project;
- ➢ Principal investigator;
- ➢ Statement of objectives;
- ➢ Date construction of experimental feature was completed;
- ➢ Summary of materials and methods;
- ➢ Quantity and cost of experimental feature;
- ➢ Construction Details; and
- ➢ Construction problems and a statement of how these problems might have been alleviated.

4.3 Progress and Final Reports

Progress and final reports are required by the FHWA throughout the formal evaluation period as stated in the work plan and should be completed within 30 days of the performance evaluation. Reports consist of a performance summary of the experimental feature to date. The final performance summary should contain information on the experimental feature as specified in the work plan, including implementation recommendations. Implementation recommendations should also be presented to MDT management. This report is due by the end of the final evaluation year.

4.4 Product
Adherence to these procedures ensures that useable and accurate information, including appropriate implementation recommendations are obtained through the incorporation and evaluation of experimental features in construction and maintenance projects.

CHAPTER 5
TECHNOLOGY TRANSFER

Research may be described as the careful, systematic study to advance knowledge in a specific field, but the crux of the program for the state is in the application of research results. Technology transfer in research goes beyond the use of the results of the research and experimental projects. Research Programs staff have acquired an expertise in a range of transportation fields. That expertise is continuously in demand by the operating units of MDT. Further, the field of transportation is dynamic, a fact that compels the research staff to keep the transportation community in Montana abreast of the latest developments.

Everyone benefits from the transportation system, and hence, from research into the system. In section 1.1, Purpose, the ultimate beneficiaries of research were stated to be the MDT's customers. The technology transfer activities of research are directed to the immediate customer, with the larger community in mind.

The partners of research, as defined in section 2.1, Research Partners' Support Development, are also the beneficiaries of research. Gaining the support of the beneficiaries of research was discussed in section 2.1. The partnerships formed with MDT operating units, universities, companies, transit authorities, tribal authorities, consultants, local governments, regional agencies, other states, FHWA, and the public will require constant renewing. The transfer of technology cannot be accomplished without the concurrence and assistance of these partners.

Research Programs staff will be active participants in technology transfer activities in the following ways:

➢ Post research and experimental projects documents (proposal, reports, project summary, etc) to both MDT's Intranet and Internet sites and keep these sites up-to-date.
➢ Highlight Research Programs services and activities through brochures, newsletters, annual reports, etc.
➢ Offer training on various services and products.
➢ Continuously examine progress of research and experimental projects to ensure that the deliverables are amenable to implementation.
➢ Advanced results of research and experimental projects for implementation.
➢ Avail expertise of Research Programs staff to the operating units of MDT for problem solving.
➢ Maintain a library of transportation publications, searchable via the Intranet and Internet. This is the Department's library. Catalog collections of items in locations other than Research, as appropriate.

- ➢ Make available results of promising research from other agencies and publications to the MDT's operating units.
- ➢ Disseminate information on FHWA Demonstration projects to MDT staff and analyze for potential workshop sessions.
- ➢ Design, install, and analyze experimental features in construction.
- ➢ Develop committees, institutional discussions, and seminars to involve potential partners in the research process.
- ➢ Attend important regional and national meetings, and disseminate the results to MDT.

All possible methods of collecting and disseminating information on transportation improvements will be pursued. The results of this activity fosters implementation, avails the Research Programs' partners of staff expertise, and keeps the transportation community apprised of the latest advances in the field.

5.1 Transportation Databases

The basis of research support is the information it provides its customers. Despite the expertise of the staff, there are many informational requests made of research that require a search of ongoing and published research. An analysis of problem statements, potential experimental projects, and informational requests must consider the literature defining the state of the art of the subject. The Transportation Research Board's RiP and TRIS databases are the single most comprehensive files of active and completed research, respectively, on all subjects in the field of transportation.

A search of these databases for information on a subject starts with a selection of the appropriate keywords. If the keywords are too broad in scope, too much information will be returned; it will be very time consuming to siphon that which is important to the search. Conversely, if the keywords are too specific, very limited information may be returned. A selection of keywords should be made after discussing the subject with the customer. Only then can the search structure be properly set up. It's important to structure the search so that the information available to the user adequately covers the subject.

A summary of the findings of the search will be developed from the abstracts of the search, which serves as the basis for defining further study of the subject. If the search is made for a customer, a review of the synthesized material with the customer should be the most helpful means of deciding follow up procedures. If the search is made as part of the literature search process at the outset of a project, the synthesis serves as background material for the research.

A study of the abstracts should lead to an in-depth review of some articles. For the more esoteric subjects, this is a necessary step. It could lead to additional keywords and the suggestion that another informational system may have to be accessed.

In addition to providing literature searches, training is provided periodically so that customers if they so choose can conduct searches on their own, requesting Research Programs' assistance as needed. Training is provided at least quarterly and covers searching various libraries catalogs and databases, including, but not limited to Montana Shared Catalog, which includes MDT's on-line catalog; other Montana library catalogs; transportation agency catalogs, such as the Northwestern University Transportation catalog and the UC-Berkeley transportation catalog; TRIS; RiP; WorldCat; and the Transportation Libraries Catalog (TLCat).

As each new research project is funded and experimental project is initiated, Research Programs' staff enters project information into the RiP database. Likewise as each project is completed, Research Programs staff ensures the final report (and any other reports as appropriate) is cataloged in TRIS. When a report for each project is cataloged in TRIS, the project is deleted from RiP. These databases are only as good as the data provided. Research Program staff makes the commitment to keep MDT's information updated.

CHAPTER 6
PROGRAM EVALUATION

6.1 Project Level Reporting

As the research effort focuses on customer benefit, it is conducted with an eye toward implementation. The implementation process is dependent on the exchange of information, which begins with clear, concise, and complete project reports. These reports detail the progress and accomplishments of research and experimental projects, and are written with the customer in mind. The proper reporting of the projects enhances the evaluation of the entire research program.

The principal investigator for all projects is responsible for writing progress reports, a final research report, a project summary, and interim research reports, if any, and making any oral presentations as required by the research contract. Guidelines for writing these reports are posted on MDT's Research Programs' Intranet and Internet sites. The Technical Panels are responsible for reviewing all reports resulting from their research.

Progress reports will include at least the following information:
  ➢ Discussion of each of the major tasks outlined in the work plan and whether they have been completed or are still in progress;
  ➢ Planned and actual time schedule for each of the tasks, including the overall percent complete using the expended versus planned budget;
  ➢ Discussion of financial, staff, equipment, and technical problems as they affect the individual tasks, as well as their resolution or attempts at resolution;
  ➢ Discussion of major accomplishments or discoveries and their significance especially with respect to implementation; and
  ➢ Fiscal expenditures.

Final research reports will include at least the following information:
  ➢ Credit reference to the MDT and FHWA on the cover and title sheets;
  ➢ Technical Report Documentation Page;
  ➢ Disclaimer statement;
  ➢ Alternative format statement;
  ➢ Table of contents;
  ➢ Executive summary , including a brief description of the work and conclusions;
  ➢ Introduction, including the problem, its background, and a concise history of research;
  ➢ Work plan, including the experimental research plan, data collection, description of sites and activities, and an analysis of the data; all data should be expressed in metric units with English units following in parentheses;

- ➢ Findings and conclusions;
- ➢ Recommendations, based on the findings and conclusions;
- ➢ Implementation Plan, defining the procedure to introduce the results into practice, including suggestions for organizational responsibility and documenting the benefits; and
- ➢ References or literature cited.

The Montana FHWA Division Office is given the opportunity to review all reports through technical panel membership. A Research Project Summary and research seminar presented at the MDT by the principal investigator will accompany each final report. The Research Programs will be responsible for the distribution of all final reports (Appendix E).

Progress reports are used to monitor progress, and interim (if any) and final reports are the official documentation of the research and form the basis for discussion of the research and presentations to the transportation community. The output of this section is the technical and financial status of a project in cyclical and final report form that is the basis for the implementation effort.

6.2 Overall Program Performance

The expenditure of public funds is subject to careful scrutiny. The profit motive does not exist in the public arena; hence, the programs in the public arena that receive these funds must prove their value through periodic reviews and assessments. After carefully selecting problem statements (section 3.2) and developing the work program (section 3.6), the research effort must follow well-defined and scientifically based procedures that ensure unbiased and meaningful results. On an individual project basis, these results are very meaningful. On a program basis, the project's results and implementation efforts should be aggregated to appreciate the cumulative effect of the program.

The work program is the sum of all activities planned for the year. These activities are primarily research and experimental projects, technology transfer efforts and technical assistance, seminars, and implementation efforts. Each funding source used for research has been programmed for the various activities in the work program. In addition, each activity has a specific budget. A record will be kept for both the project level and funding source expenditures. An Annual Research Programs Report documenting all Research Programs activities on an annual basis will be developed and distributed.

The individual projects are the most important activities as far as schedules are concerned. Most other activities can be planned throughout the year. The ability to adhere to the schedule for a project is contingent on many factors. The Research Programs' staff will be in frequent communication with the principal investigators to avert major slippage.

The documentation of successful performance of the research effort is important to continue to receive the management and financial support that it requires. Objective and quantifiable parameters can give the basis for this support. Overall program performance can be measured by a combination of the achievement of implementation and milestones, and a qualified adherence to financial and scheduling limits.

6.3 Peer Exchange

A quality MDT Research Program depends upon its ability to implement effective and timely solutions to the MDT's problems. It is the execution of the well-planned procedures and processes that ensures the attainment of this objective. One technique designed to improve the quality of the program is a peer exchange of the Research Programs deliverables through this management system. A panel, with knowledge of state research programs, will bring that expertise to a study of the research process and advance recommendations to enhance its performance.

The exchange team may consist of representatives selected from FHWA, universities, Transportation Research Board (TRB), private sector, other agencies and the research units of other states. The cost of travel of the peer exchange team will be charged against the SPR program and is eligible for 100% federal funding.

The peer exchange team will spend at least two days with Research Programs staff. The scope of each peer exchange will vary due to the needs of the MDT and requests of the exchange team, but may include:
  ➢ Discussion of the Research Programs' management system, as described in this manual;
  ➢ Scope of the Research Programs, including all the activities in the work program;
  ➢ Examples of a project as it advances through the system, including the solicitation, selection, choice of researcher, project progress, and technology transfer activities;
  ➢ Discussion with research partners;
  ➢ Review of resources;
  ➢ Review of staff training program;
  ➢ Review of contract process;
  ➢ Review of technology transfer efforts and implementation activities; and
  ➢ Discussion of recommendations in the form of the processes of other states.

The Research Programs staff will conduct a peer exchange at least once every three years.

The peer exchange team will write a report on the visit that covers all aspects of the agenda items. The report will summarize the discussions, itemize the findings and reiterate the recommendations discussed with the Research Programs Manager. Copies of the report will be filed with the Research Programs and the Division office of the FHWA.

The peer exchange is a vigorous effort conducted for the benefit of the Research Programs. It will be accomplished by peers to improve research management and processes. The

recommendations of the team will be discussed with Research Programs staff and the MDT management. Every effort will be made to incorporate those recommendations that can improve the quality of the Research Programs.

6.3.1 External Exchange

Staff of the Research Programs will be available and encouraged to serve as peer exchange team members. The staff will perform, in another state, the same exchange that was described above in Section 6.3, Peer Exchange. The state holding the peer exchange will be responsible for the travel costs incurred by their reviewers.

6.3.2 Product

The peer exchange process is designed to encourage states to interact with other states on a formal exchange basis. Staff can both learn from and give guidance to other agencies on the research management and processes. This is an excellent opportunity to participate in and gain the benefits of a nonintrusive review of the MDT's Research Programs.

APPENDIX A: MODEL CALENDAR

January

NCHRP Synthesis of Practice topics due
TCRP Panel nominations due
RAC/SCOR meet during TRB Annual Meeting
TRB National Meeting in Washington, D.C.
*Monthly MDT RRC Meeting – Solicitation Research Ideas to be Ranked

February

NCHRP Ballots on new problem statements due
Obligation of NCHRP funding due (month may vary)
*Monthly MDT RRC Meeting

March

NCHRP summary of ballots distributed to SCOR
Schedule and guidance for TRB annual state visits distributed
SCOR meets to select new NCHRP projects
TRB Core program contributions due for states that contribute under Pooled Fund
Program option
TCRP Synthesis of Practice topics due
Nominations for new AASHTO TIG topics due
*Monthly MDT RRC Meeting – Champion Presentation of Research Proposals

April

Preliminary NCHRP program announced
*Monthly MDT RRC Meeting

May

NCHRP Synthesis of Practice topics selected
NCHRP panel member nominations due
TCRP Synthesis of Practice topics selected
TIG Request for Topics
*Monthly MDT RRC Meeting

June

FHWA SP&R annual work plan due (month may vary depending on fiscal year calendar used by state)
TCRP problem statements due
TRB Call for papers for 2005 Annual Meeting
State CEO ballot on NCHRP program due
*Monthly MDT RRC Meeting

July

AASHTO Research Advisory Committee (RAC) national meeting (month may vary)
*Monthly MDT RRC Meeting

August

LTAP National Meeting (month may vary)
TRB Annual Meeting abstracts due Aug. 1
State report to FHWA on SP&R funded accomplishments due
*Monthly MDT RRC Meeting

September

NCHRP problem statements due
AASHTO Annual Meeting (month may vary)
*Monthly MDT RRC Meeting

October

TRB Annual Meeting preliminary announcement distributed
New TCRP Projects Selected
*Monthly MDT RRC Meeting

November

NCHRP Problem submitters' responses to evaluations due
*Monthly MDT RRC Meeting

December

MDT Research External/Internal request for solicitations
NCHRP Ballot on new projects distributed to SCOR and RAC

*Monthly MDT RRC Meeting

*Occurs last Tuesday of every month, subject to change or cancellation

Glossary of Abbreviations

AASHTO - American Association of State Highway and Transportation Officials
CEO - Chief Executive Officer (of state Department of Transportation)
FHWA - U.S. Federal Highway Administration
LTAP - FHWA Local Transportation Assistance Program
MDT - Montana Department of Transportation
NCHRP - National Cooperative Highway Research Program
RRC - Research Review Committee
RAC - AASHTO Research Advisory Committee
SCOR - AASHTO Standing Committee on Research
SP&R - State Planning and Research Funds, a proportion of the Federal Aid funding
TCRP - Transit Cooperative Research Program
TIG - AASHTO Technology Implementation Group
TRB - Transportation Research Board

APPENDIX B: RESEARCH PROBLEM STATEMENT

Montana Department of Transportation

MDT

serving you with pride

STAGE I RESEARCH PROBLEM STATEMENT

I.   PROBLEM TITLE (required):

II.   PROBLEM STATEMENT (required):

III.   RESEARCH PROPOSED (required):

IV.   IT COMPONENT (required): Identify if the project includes an IT component (purchasing of IT hardware, development of databases, acquisition of existing applications, etc) or not. If so, describe IT component in as much detail as possible.

V.   URGENCY AND EXPECTED BENEFITS (required):

VI.   IMPLEMENTATION PLAN (required):

VII.   SUBMITTED BY: (required)
NAME_____
TITLE_____
AFFILIATION_____
ADDRESS_____

_____
PHONE NO._____
E-MAIL_____

VIII.   CHAMPION: (Must be internal to MDT)
NAME_____
TITLE_____
AFFILIATION_____
ADDRESS_____

_____
PHONE NO._____
E-MAIL_____

IX.   SPONSOR(S): (Internal to MDT, Division Administrator or higher)
NAME(S)_____
PHONE #(S)_____
E-MAIL(S)_____

Note: Submitter may attach continuation sheets if necessary.

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APPENDIX C: RESEARCH PROJECT STATEMENT

Title:_____

Problem Description:_____
_____
_____
_____

Importance:_____
_____
_____
_____

Literature Summary:_____
_____
_____
_____

Are research results already available?_____ If so, how can MDT implement these results?_____
_____
_____
_____
_____

In summary, does research needs exist?_____ Explain:_____
_____
_____
_____
_____

Research Objectives:

    1)_____
    2)_____
    3)_____

Research Tasks:

    1)_____
    2)_____
    3)_____

Potential Implementation, including barriers to implementation and products necessary for implementation: _____
_____
_____

Budget Estimate: $_____
Study Duration: _____months

MDT Involvement:_____
_____

Recommendation:

    __No Research   __In-house Research   __Contract Research
    __NCHRP   __Pooled Fund

Explain:

Technical Panel

Instructions

These instructions are intended to help technical panels develop Research Project Statements. Each panel should complete a statement form cooperatively at its first meeting.

Title

State the title of the research study as you think it should be stated. The title should be brief, but should convey the general idea of the study. You are free to modify the title listed on the original problem statement.

Problem Description

Describe the problem that appears to require research. Identify the nature of the problem. What factors might contribute to the solution? What aspects of the problem may affect the result? Try to be as specific as knowledge permits.

Importance

Describe the importance of this study. What real world costs are associated with the problem? Will the problem continue unless research is done? Does future MDT activity depend upon this research? What savings in money or time might result from the research? Can the research be postponed to another year? Would the research be completed prior to a major implementation (timeliness)?

Literature Summary

Briefly summarize information available from previous research. Is this problem widespread? Do other's consider it to be important? What work has been done to solve the problem? Would that research apply to our problem? How successful was it?

Results Already Available

If prior research is sufficient to provide a solution to the problem, recommend what MDT can do to adopt these results. Be specific. Identify what would have to be done, who would have to do it, how much it would cost, and what it would accomplish.

Research Need Evaluation

Recommend whether research is needed based upon your evaluation so far. Briefly explain your decision.

Research Objectives

Define the purpose of the research—that is, what it should accomplish. At this point, focus on the goals of the research, but not the details of how they will be achieved. Make sure the goals respond to the needs outlined in the problem description, so the research will actually produce a solution.

Research Tasks

In this section, list the specific tasks you think a researcher needs to perform to meet the objectives listed above. Be specific enough to ensure that the work gets done, but not so specific that no room for innovation is left. The tasks should be clear, so a researcher can intelligently estimate how much effort they will entail. Example tasks might include: literature review, surveys, data collection and analysis, and product development.

Potential Implementation

Describe how you think MDT could implement the results. Are specification changes anticipated? Procedural changes? Organizational changes? New designs or materials? Determine any barriers to implementation and hoe to eliminate these barriers. Determine the products that will be necessary for implementation.

Budget Estimate

Estimate the cost of the proposed research and its duration. Consider only the cost of the research, not of associated construction. Your estimates will be somewhat arbitrary, but nonetheless will very likely become the actual project limits. Use your best judgment.

Federal Highway Statewide Planning and Research (SPR) funds will be used.

MDT Involvement

Identify any involvement in the research that will be necessary by the Department. Consider construction costs, traffic control, materials sampling, heavy vehicles and crew, information, or anything else that might be required. Estimate costs.

Recommendation

Recommend what action you feel appropriate. The alternatives and their criteria are listed below. Your recommendation will be the main factor in the Research Review Committee's consideration of the study. Whatever your recommendation, offer some explanation.

1. No Research: You may recommend that no research be done (even if a research need apparently exists) if:

   ➢ Insufficient need exists
   ➢ Cost outweighs benefits
   ➢ Success is unlikely

2. In-House Research: You may recommend that the research be conducted in-house if a research need exists, the Technical Panel would like to proceed with research, and the effort is relatively small and can be addressed with current resources.

3. Contract Research: You may recommend that the research be contacted to an outside entity if a research need exists, the Technical Panel would like to proceed with research, and the effort more than be conducted in-house. Most project fall into this category.

4. NCHRP: You may recommend research as an NCHRP project if the research need is of national significance and the need is not immediate as the NCHRP process can be lengthy and competition is fierce.

5. Pooled fund: You may recommend research as a pooled-fund project if the need is of regional or national significance

Technical Panel

List the project technical panel members.

APPENDIX D: PREPARATION AND SUBMISSION OF PROPOSALS

The MDT Research Programs solicits research proposals from colleges, universities, research institutes, professional consultants, government agencies, and others who possess extensive, demonstrated capability, and experience in the subject areas. Research Programs procedures as detailed below are followed for contracts with all governmental agencies. MDT Purchasing and Consultant Design bureaus' procedures are followed for all other contracts.

Proposal Submission

Proposers must submit their proposals to the Research Programs to arrive on or before the time and date specified in the Request for Proposal (RFP), if applicable. Proposals arriving after the deadline may be considered in later time frames. The Research Programs will acknowledge receipt of proposals. All proposals submitted become the property of the MDT. The MDT reserves the right to use all information presented in any proposal, unless it is annotated as proprietary. Selection or rejection of a proposal does not affect this right. The MDT reserves the right to reject any and all proposals submitted. It may, under certain conditions, negotiate with a proposer to address specific weaknesses in a submitted proposal. The MDT is not responsible for any costs incurred by potential researchers, prior to the execution of a contract. Furthermore, costs of developing the proposal are not a reimbursable item to the successful research agency.

Proposal Organization

The research proposal should be a well-prepared document that defines the research problem and objectives, provides a detailed work plan for achieving the objectives, and indicates how the research findings are expected to be used. Proposals should provide a straightforward description of the researcher's ability to meet the requirements of the RFP, if applicable.

The following instructions are intended to help researchers prepare a proposal that will be accepted with a minimum of changes. Proposals must comply with these instructions to be considered. Failure to comply will seriously jeopardize the proposal's chances of selection.

Title Page

The proposal cover should include the following information: title, submitter information, submitted to, and date.

Table of Contents

On a separate page, list the proposal's sections and page numbers.

Problem Statement

Concisely express your understanding of the problem presented. If the proposal is in response to an RFP, do not repeat the wording of the RFP; rather, demonstrate your insight into the problem.

Background Summary

Include background information on the research topic. Summarize the findings of a preliminary literature search and state the relationship of the proposed study to prior research. The summary should reveal your understanding of underlying principles and should clearly indicate your appreciation of the problem.

The importance of this part of the proposal should not be underestimated. A comprehensive background summary ensures that all aspects of the research topic have been adequately considered so new research can build upon prior work rather than duplicate it.

Objectives

State the technical objectives of the study. Explain and justify any deviations from the objectives listed in the RFP, if applicable.

Benefits

Identify potential benefits expected from the research. Describe how the research results can be used, and by whom, to improve transportation practice. Possible benefits are:
  - ➢ Cost savings (both the MDT and the and affected public);
  - ➢ Increased safety;
  - ➢ Improved service; and
  - ➢ Improved procedures.

Research Plan

Describe how the objectives will be achieved through a logical and innovative plan. Use the task descriptions given in the RFP, if applicable, as a basis for developing the research plan. Specifically identify the tasks that will be performed. Explain and justify any deviations from the tasks listed in the RFP, if applicable.

The plan should also describe the technical basis of the research. Describe the following, as appropriate:
  - ➢ Principles of theories to be used;
  - ➢ Significant variables to be tested;
  - ➢ Analytical and statistical procedures;
  - ➢ Experimental and testing procedures;

- ➢ Evaluation criteria;
- ➢ Inspection and survey methods;
- ➢ Controls to be used; and
- ➢ Material, procedure, or device development.

The plan should be complete, providing the greatest level of detail that the researcher's understanding of the problem permits.

Products

List the products that will be delivered during the research project. Deliverables might include:
- ➢ Reports;
- ➢ IT Components;
- ➢ Manuals;
- ➢ Photographs;
- ➢ Video or other audio/visual materials; and
- ➢ Physical models.

Unless directed otherwise in the RFP, if applicable, always include the following items as products:
- ➢ Progress reports;
- ➢ Final report; and
- ➢ Project summary report.

Implementation

Describe how the research results can be applied by MDT. Include the following:
- ➢ Describe the form in which the findings may be reported, such as a mathematical model, a laboratory test procedure, or a design technique. Describe these results in terms of the practicing engineer or administrator.
- ➢ Identify who would logically be responsible for applying the research results, such as the American Association of State Highway and Transportation Officials (AASHTO), FHWA, MDT, or a particular office within MDT.
- ➢ Identify specific standards or practices that might be affected by the research findings, such as AASHTO or MDT specifications, MDT policies and procedures, legislation or fiscal requirements.
- ➢ Submit an implementation plan tied to performance measures. If an IT component is part of the implementation submit a work plan for update and maintenance.
- ➢ If findings will not be suitable for immediate application at the conclusion of the research project, indicate what further work might be necessary.

It is understood that the actual research may produce unanticipated findings, making

changes in the implementation plan necessary. This is acceptable. The proposal selection, however, will be greatly influenced by the practicality and direction of the implementation plan presented in the proposal.

Time Schedule

Provide a bar chart or other graphical presentation illustrating the scheduling of the major research tasks on a monthly basis (Figure 3). Always allow one month for the MDT review of draft reports.

Activities	Month 1		Month 2		Month 3		Month 4		Month 5		Month 6		Month 7		Month 8	
Kick-Off Meeting																
Task A. Review of Current Ride Specification																
Task B. Literature Search																
Task C. Conduct State of Practice Survey	Develop Draft		MDT Review	Conduct Survey												
Task D. Recommendations																
Task E. Implementation Plan																
Draft Final Report											Submit					
Final Presentation																
Final Report																

*The schedule also contains monthly progress reports.

Figure 3: Sample Task Time Schedule

Staffing

Include pertinent background information for principal investigators and other team members significantly participating in the project. Describe how academic, professional, and research experiences relate to the project. Include a summary of past accomplishments in the same or closely related problem areas.

Provide a table showing the number of person-hours (not percentages of time) that will be devoted to each task by research team members, as illustrated in Figure 4. List the names of principal investigators and other key professionals who will be involved. Support personnel may be identified by classification.

Name of Principal, Professional, Employee, or Support Classification	Role in Study	Task					
		1	2	3	4	5	Total
Professor A	Principal Investigator	20	30	10	0	10	70
Professor B	Co-Principal Investigator	15	25	20	20	0	80
Graduate Student 1	Field Testing	10	15	5	10	10	50
Graduate Student 2	Analysis	10	15	5	15	5	50
Administrative Staff	Administrative Support	5	5	5	10	5	30
Clerical Staff	Report Preparation	5	10	5	10	20	50
TOTAL		65	100	50	65	50	330

Figure 4: Sample Breakdown of Person Hours

List current commitments to other work in sufficient detail to permit assessment of the researcher's ability to meet the proposal's commitments. Include a statement that the level of effort proposed for principal and professional members of the research team will not be changed without written consent of the MDT.

Facilities

Describe the facilities available to accomplish the research. Indicate equipment that is necessary for completion of the research and specify any restrictions on its use. Specify any equipment that is necessary but not currently on-hand. If additional equipment is to be purchased with project funds, identify it in the budget estimate.

MDT Involvement

Describe any assistance that may be required from the MDT. Include such items as:
 ➢ Traffic control;
 ➢ Construction;
 ➢ Highway maintenance;
 ➢ Drilling and sampling;
 ➢ Access to transportation facilities;
 ➢ Access to written information or databases; and
 ➢ Interviews.

Budget

Show the detailed and fully itemized project cost for by both the federal and state fiscal years by task. The federal fiscal year runs from October 1 to September 30 and the state fiscal year runs from July 1 to June 30. Because of budget constraints, additional funding is highly unlikely. No budget extensions should be anticipated.

APPENDIX E: REPORT DISTRIBUTION

INSTITUTION	NUMBER OF COPIES
National Technical Information Service, Room 303F 5285 Port Royal Road Springfield, Virginia 22161	10
University of California TRISNET Repository Institute of Transportation and Traffic Engineering Berkeley, California 94720	2
Northwestern University TRISNET Repository Transportation Center Library Evanston, Illinois 60201	2
Transportation Systems Center TRISNET Repository Kendall Square Cambridge, Massachusetts 02142	2
Department of Transportation Library 400 7th Street, SW. Washington, D.C. 20590	2
Transportation Research Board Library 2101 Constitution Avenue Washington DC 20418	2
FHWA Divisional and Regional Offices Planning and Research Coordinator Federal Highway Administration 301 South Park St., Drawer 10056 Helena, MT 59626-0056	6
FHWA Associate Administrator for Research and Development (HRD-10) Federal Highway Administration 6300 Georgetown Pike McLean VA 22101	5
Montana State Library Documents Section 1515 E. Sixth Ave. P.O. Box 201800 Helena, MT 59620-1800	8

Technical Reference Center Federal Highway Administration 6300 Georgetown Pike Room A200 McLean VA 22101	2
US DOT National Transportation Library 400 7th Street, SW. Room 7412 Washington, D.C. 20590	1
MDT Districts and Areas	16

Reports are also distributed to states as per requested distribution (http://cms.transportation.org/sites/research/docs/RACPaperRptMailLabels.pdf), the technical panel, other interested parties, and within the MDT. They are also posted on MDT's Intranet and Internet sites.